Name_____ Date_____

Mrs. Roumbos 8A Period_____

Graphing exponential functions

An exponential function: $y = ab^x$. The basic graph of this function is a curve that approaches the negative x-axis , but never crosses it. (Only in quadrants I & II) The graph always crosses the y-axis at (0,1). Changing the coefficient of x (the exponent) to a negative number reverses the direction of the curve, where negating the base would reflect the graph (turn upside down) into quadrant III & IV. The base of the exponent will determine if the graph has growth or decay (see below)

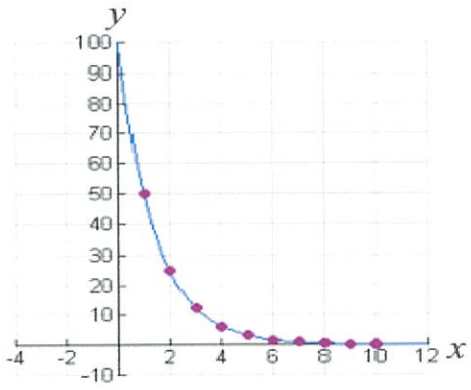
Observe how the graphs of exponential functions change based upon the values of *a* and *b:*

$$y = a \cdot b^x$$

Example: $y = 100 \cdot (0.5)^x$

when $a > 0$ and the *b* is between 0 and 1, the graph will be decreasing (decaying).

For this example, each time *x* is increased by 1, y decreases to one half of its previous value.



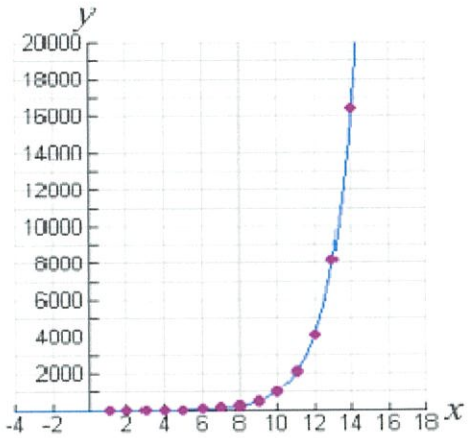
Such a situation is called **Exponential Decay.**

$$y = a \cdot b^x$$

Example: $y = 1 \cdot (2)^x$

when $a > 0$ and the *b* is greater than 1, the graph will be increasing (growing).

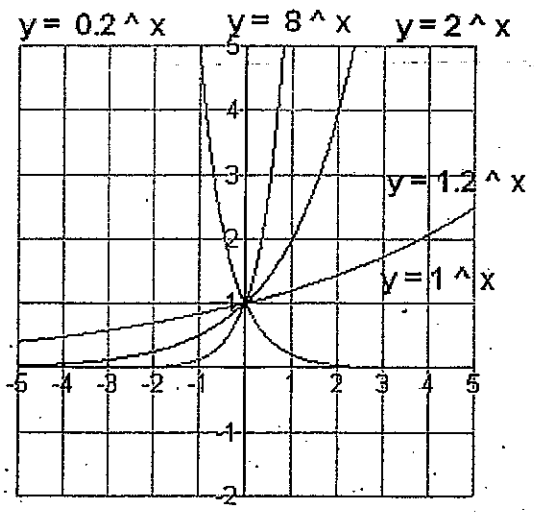
For this example, each time *x* is increased by 1, y increases by a factor of 2.



Such a situation is called **Exponential Growth.**

These graphs are **ALWAYS in quadrants I & II.

Exponential Functions:



Notice that all of the exponential graphs pass through the point (0,1). This occurs because values raised to the zero power equal 1.

Exponential functions have the variable x as an exponent.
Form being examined is $y = a^x$.

Some Observations:

1. As the base value (a) gets larger, the graph becomes steeper faster - it appears to stretch upward more quickly.

2. As the base value (a) gets closer to 1, the graph flattens. If the base were to become one, the graph would be a horizontal (flat) straight line (not an exponential graph).

3. If the base value (a) is between 0 and 1, the graph appears to have reflected itself over the y-axis. The graph has just turned from exponential growth to exponential decay.

VOCABULARY

An **exponential function** is of the form $f(x) = ab^x$, where $a \neq 0$ and $b > 0$, $b \neq 1$.

Exponential growth involves the exponential increase of a quantity over time, which is represented by $y = a \cdot b^x$, where $a > 0$ and $b > 1$.

Exponential decay involves the exponential decrease of a quantity over time, which is represented by $y = a \cdot b^x$, where $a > 0$ and $0 < b < 1$.

Exponential decay often involves finding the **half-life** of an object, which is the time needed for an amount of a substance to decrease by one-half.

Example 1

$y = 2^x$ *or* $f(x) = 2^x$. Graph approaches but does not cross the negative x-axis. The y-intercept is (0, 1)

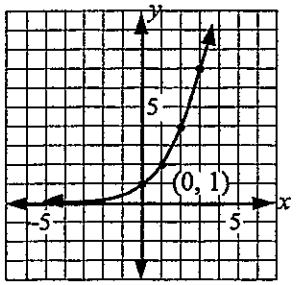


Table of Values $f(x) = 2^x$	
x	y
–3	0.125
–2	0.25
–1	0.5
0	1
1	2
2	4
3	8

Example 2

$y = 2^{(-x)}$ In this example, the coefficient of x is –1. The graph decreases as it goes from left to right. It has (0, 1) as its y-intercept, and now it approaches but never crosses the positive x-axis.

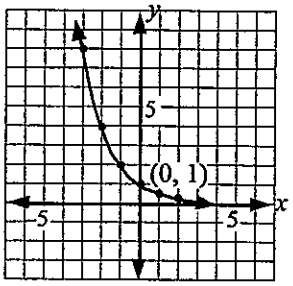


Table of Values for $y = 2^{(-x)}$	
x	y
–3	8
–2	4
–1	2
0	1
1	0.5
2	0.25
3	0.125

Part I Ex's

1) Given $y = 3^x$, evaluate y when $x = 3$

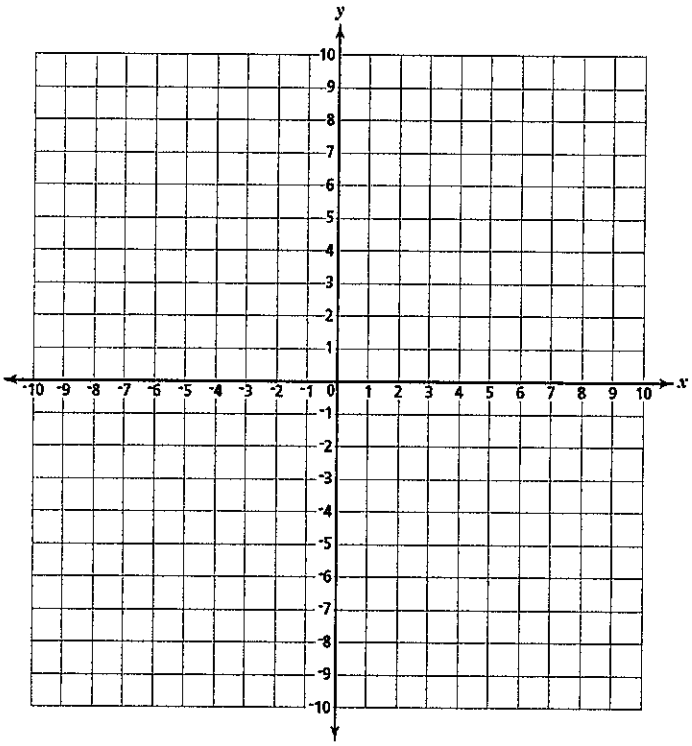
2) Would the graph of $y = 0.5^x$ show exponential growth or exponential decay?

3) Which ordered pair represents the y-intercept for the function $y = 2^x$?

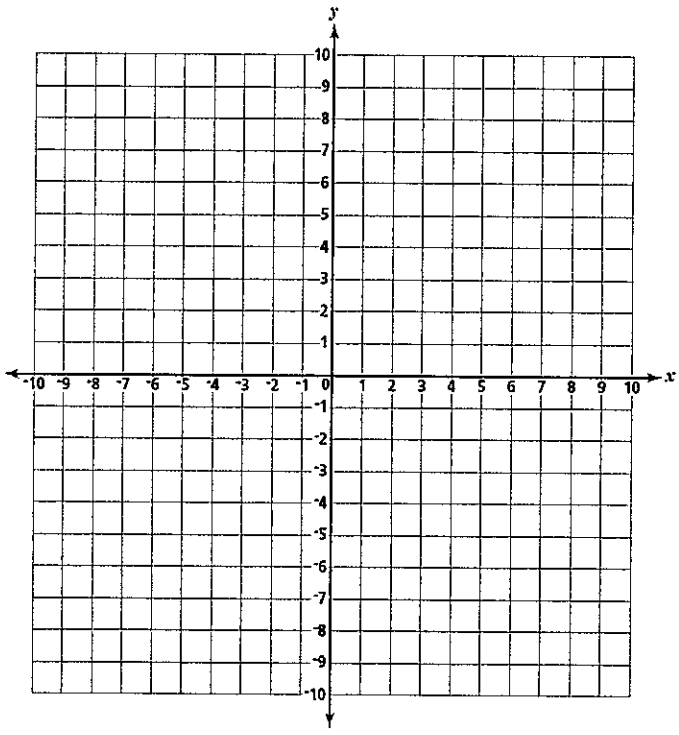
4) The graph of $y = 2^x$ lies in which Quadrants?

Graph the following:

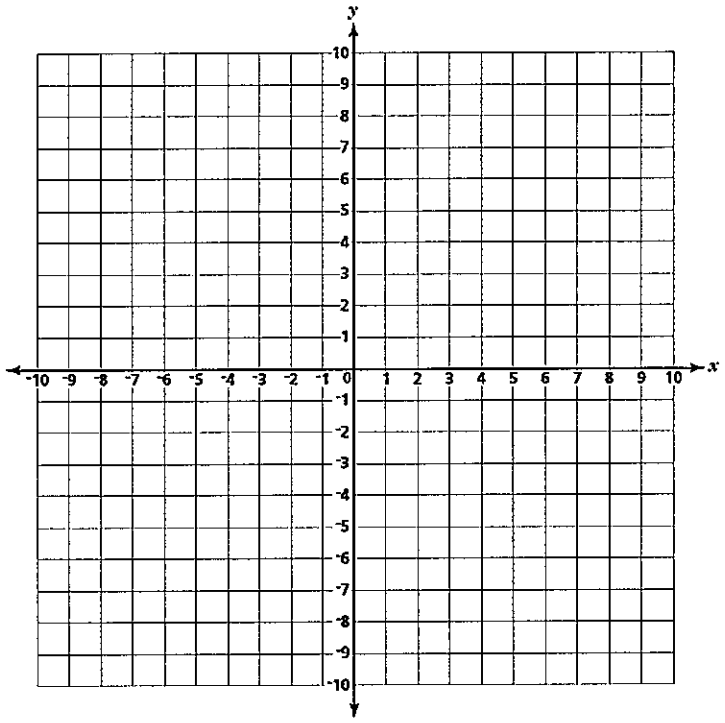
1) Draw the graph of the equation $y = 2^x$ in the interval [-3,3]



2) Draw the graph of the equation $y = (\frac{1}{2})^x$ in the interval [-3,5]

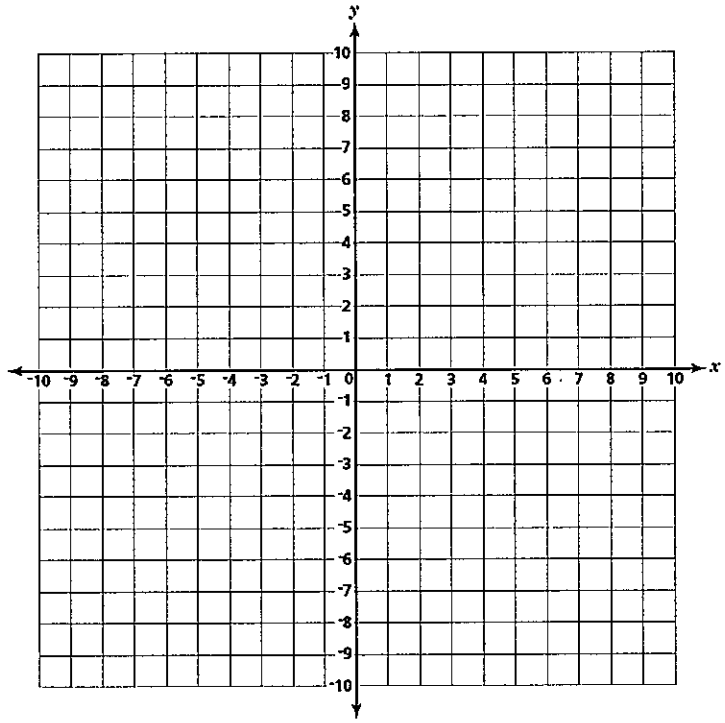


3) $y = 3^x + 1$ $[-2, 2]$



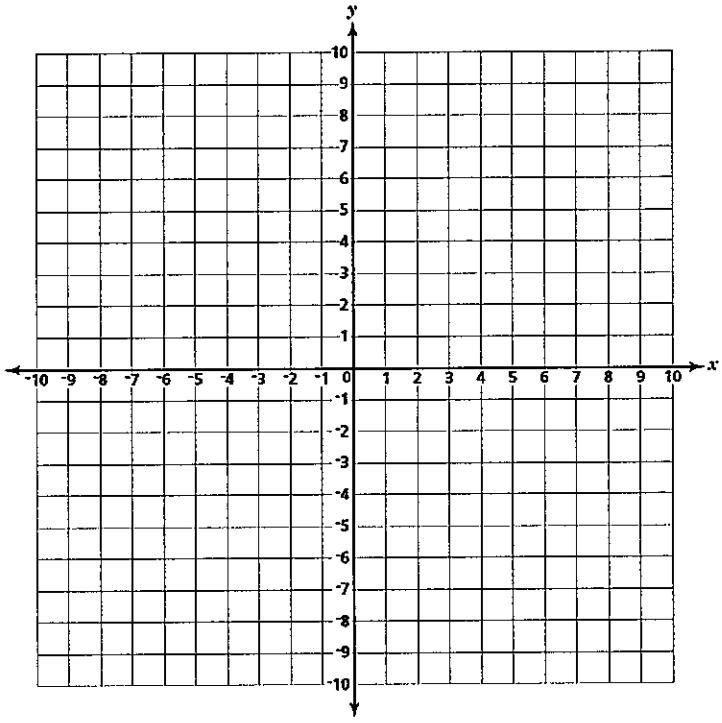
Explain the transformation:_____

4) $y = 2^{x-3}$



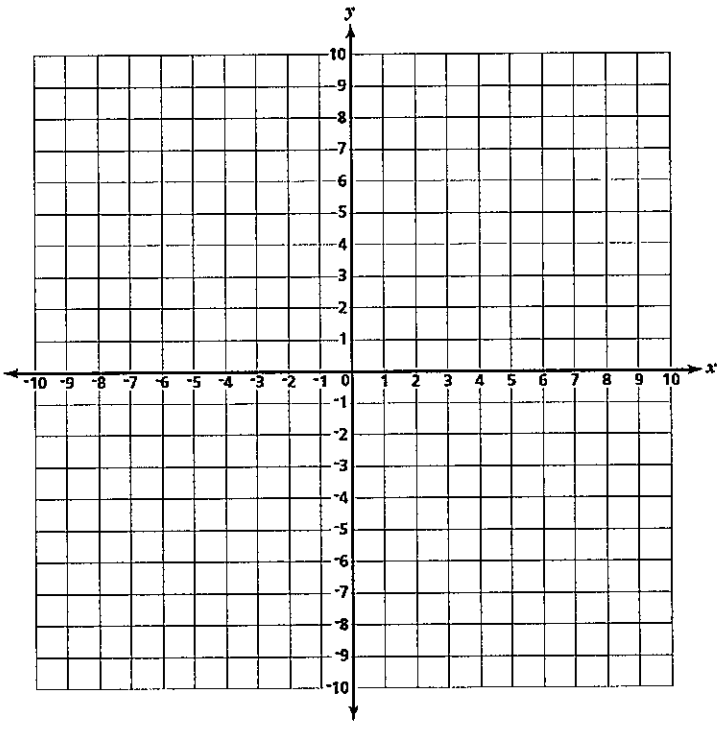
Explain the transformation:_____

5) $y = -2^x$ $\quad -2 \le x \le 3$



Explain the transformation:_____

6) $y = 3^{-x}$



Explain the transformation:_____